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# Soil Conservation

August 1978

U.S. Department of Agriculture

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From the Administrator

# Meeting Clean Water Goals

In 1972, the Federal Water Pollution Control Act Amendments challenged Americans to make our waters fishable and swimmable by 1983. To many, cleaning up the Nation's polluted rivers and lakes seemed an impossible task. It also seemed an incredibly broad challenge because pollution comes from so many different sources.

The American people, however, took up the challenge. They first attacked point pollution source by source.

Now attention is turning to nonpoint pollution, and conservation districts and SCS are in the vanguard of those trying to solve this problem.

Nonpoint pollution is diverse. In some places the worst pollutant is animal waste; in others, it is salty irrigation return flows. Nationwide the biggest pollutant, by volume, is sediment. In addition, sediment frequently carries other pollutants into our waters, such as fertilizers and pesticides.

Although the problem is complex, we have found that the best way to control pollution is by concentrating our effort in a rifle approach instead of a shotgun approach.

A small percentage of the land in many watersheds contributes most of the nonpoint pollution. Working with the U.S. Environmental Protection Agency and State 208 planning agencies, districts and SCS are helping to identify the areas that contribute the most pollution and are carefully designing and selecting practices tailored to take care of them first.

Best management practices (BMP's) include improved systems for controlling pollution originating from agricultural activities—better erosion control, integrated pest management, efficient irrigation, and safe disposal of animal waste.

The cost of installing BMP's would be a financial burden to some individuals, particularly farmers and ranchers. Recognizing this, Congress last year passed the Clean Water Act. The act calls for a Rural Clean Water Program that will provide financial and technical assistance to rural land users installing BMP's under long-term contracts.

The Rural Clean Water Program reinforces our rifle approach: cost sharing will be available only in authorized high-priority project areas. It strengthens district programs because BMP's to improve water quality often include the most needed soil conservation measures. And it greatly increases the Nation's chances of meeting our clean water goals.

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# Soil Conservation

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by David G. Unger

# Upgrading Water Quality

**Abridged version of keynote address given by Mr. Unger at the 10th annual Waste Management Conference in Rochester, N.Y., April 26-28, 1978. The conference was sponsored by Cornell University, Ithaca, N.Y., and the U.S. Environmental Protection Agency.**

The overall job of upgrading water quality will require an effective combination of good management, technical assistance, economic incentives, research, and education. It will need participation by individual land users as well as local, State, and Federal governments.

The U.S. Department of Agriculture (USDA) already has done a great deal to help improve the quality of our Nation's water and related resources. With new legislation—and new emphasis in our continuing programs—we will do even more.

Across the country, community after community faces difficult decisions about water resources. USDA tries to help through several programs:

- We give landowners and others a wealth of technical information, help them prepare conservation plans, and help them manage their resources and apply conservation practices.

- We compile new information through research programs and through soil surveys, vegetation studies, snow surveys, and other inventories.

- We participate in cooperative programs for protecting watersheds, preventing floods, controlling fire, conserving and developing natural resources, and managing forest lands.

- We serve as members of policy or advisory committees established by State and areawide water quality agencies and provide them with vital data.

- We manage National Forests, National Grasslands, and other units of the National Forest System, which make up some of the most important watershed areas in many parts of the Nation. We collect, analyze, and use a wide variety of resource data—much of it directly related to water quality.

- We provide information to landowners and the public about water quality problems and solutions.

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Four new Federal laws will strengthen our role in water quality management:

1. The Surface Mining Control and Reclamation Act of 1977.

Section 406 of this act establishes what we call the Rural Abandoned Mine Program. This is a voluntary program, designed to aid land users in reclaiming, conserving, and developing coal-mined lands that are either abandoned or inadequately reclaimed. Many of these lands are contributing to pollution problems. Cost sharing and technical help under the program are aimed at protecting people and the environment from the adverse effects of past coal mining, and promoting development of soil and water resources in unreclaimed areas. More than a million acres could be eligible for treatment in 377 counties in 29 States.

2. The Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA).

3. The Soil and Water Resources Conservation Act of 1977 (RCA).

The RPA, administered by the Forest Service, and RCA, administered by the Soil Conservation Service, direct USDA to make periodic assessments of America's basic natural resources and to take actions that will protect and improve these resources.

The RPA, bolstered by the National Forest Management Act of 1976, seeks to help all Americans understand that the Nation's renewable resources are important, that long-term plans are needed for managing and using resources, and that citizens can participate in designing and evaluating the plans. Under the RPA, the Secretary of Agriculture prepares a periodic assessment of renewable resources of U.S. forest and rangeland under all ownerships; and a long-range recommended program for Forest Service activities in research, in management of National Forests and National Grasslands, and in aid to States and private forest landowners.

The RCA offers a better-than-ever chance to detect the really tough soil and water conservation problems, to develop new and more effective solutions to them, and to monitor how well the job is done.

Under RCA, USDA must:

- Make a continuing appraisal of America's natural resources.
- Develop a 5-year strategy, based on the appraisal, for dealing with soil and water conservation problems.
- Evaluate annually the progress of conservation programs in carrying out the 5-year strategy.

Through RPA and RCA, local people and State agencies will blend their own plans and ideas with national multiyear programs. The RCA also will make it easier to relate soil and water conservation to the natural resource functions that the RPA assigns to Forest Service.

The RCA could turn out to be the most significant soil and water law since the origins of our national program in the 1930's. Together, RPA and RCA provide us with an unparalleled opportunity to evaluate what we are doing and to make needed adjustments.

4. The Clean Water Act of 1977.

In his Environmental Message last year, President Carter pointed out the importance of State and local planning in controlling water pollution from farms and ranches, forest lands, mines, urban streets, and other sources.

The new Clean Water Act directs attention toward such high-priority areas where sediment, nutrients, pesticides, and other pollutants pose the greatest threat to streams, waterways, and lakes. These sources of nonpoint pollution will be identified in Section 208 plans prepared by local and State agencies and approved by the Environmental Protection Agency (EPA).

The Administration has requested funds to gear up for implementation of a new Rural Clean Water Program authorized by the act. The program calls for cost-share incentives to farmers and ranchers under long-term contracts to help finance best management practices for nonpoint pollution reduction.

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USDA and EPA also have begun a Model Implementation Program (MIP) to demonstrate how a coordinated program of conservation systems can reduce nonpoint source water pollution. Our team has selected MIP project areas in seven States. The soil and water conservation work needed in these areas will begin within 6 months and most will be completed within 3 years.

USDA will continue to do everything it can to help upgrade water quality. The job will call for the best efforts of all of us.

---

Assistant Secretary of Agriculture M. Rupert Cutler has said that rural water quality management must be built on four principles:

1. A voluntary approach with farmers and ranchers that builds on existing working relationships to get the job done while preserving as much freedom of choice for private citizens as possible.
2. Economic incentives to landowners to reflect the benefits that accrue to society as a whole: economic growth, improved water quality, better wildlife habitat, esthetic values, and others.
3. Team efforts that will accomplish more than the sum of individual programs of universities, Federal and State agencies, farm groups, and conservation and environmental organizations.
4. Recognition of how many programs on land use—particularly on prime farmlands and timberlands—affect water quality.

I would like to add one more. We need more facts. Research and monitoring are critical. We are going to be spending a good deal of time and money on this problem and will be asking much from farmers, ranchers, and other landowners. We need to refine our information, gather new data on the effects of those practices selected to help achieve cleaner water, and constantly review and revise our practices and programs in accordance with what we learn.

We need to start where we are. But we need to start. And concurrently we need to learn more and as quickly as possible.

Mr. Unger is acting deputy assistant secretary for Conservation, Research, and Education, USDA, Washington, D.C.

# Conservation Practices Help Meet Clean Water Goals

**Background**

The goal of the 1972 Federal Water Pollution Control Act Amendments (Public Law 92-500) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The legislation calls for achieving water quality that is suitable for fishing and swimming by 1983 wherever it is practical to do so. The question of whether it is practically, economically, or humanly possible to accomplish these goals within the time frame of the law looms in the minds of many people.

The national investment for cleaning up point sources of pollution has been enormous, and the Federal government and industry seem committed to continuing this investment. As progress is made in controlling municipal and industrial pollution, the problem of nonpoint source pollution becomes more apparent. A concerted effort must be made to control this pollution from diffuse sources if 1983 clean water goals are to be achieved.

by James S. Johnson

Adapted from a paper presented by Mr. Johnson at the 10th annual Waste Management Conference in Rochester, N.Y., April 26-28, 1978. The conference was sponsored by Cornell University, Ithaca, N.Y., and the U.S. Environmental Protection Agency.

Nonpoint source pollution comes from many varied and diffuse sources. It is basically influenced by land use activities along with climatic, hydrologic, soil, and geologic factors. Because of the relationship of activities on the land to nonpoint source pollution, land management practices will play a major role in the cleanup. Practices that are looked to for performing this role have become widely accepted as best management practices (BMP's).

The term "best management practices" originates with the Environmental Protection Agency (EPA) guidelines for continuing planning pursuant to Section 208 of the 1972 Federal Water Pollution Control Act Amendments. The definition of BMP's in these guidelines follows:

"The term 'Best Management Practices' (BMP) means a practice or combination of practices that is determined by a State (or designated areawide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals."

BMP's to control nonpoint source pollution are being incorporated into the water quality management plans being developed in accord with the requirements of Section 208. The plans address nonpoint source control needs, and identify and evaluate measures and practices that will produce a desired level of control. The practices that are selected are placed in the 208 plan as BMP's. The basic philosophy is to treat the sources of problems as they occur on the land.

Because of the variability in sources, climate, topography, and soils, the criteria for BMP selection must be tailored to meet the needs of the site and the nature of water quality problems. The goal of BMP's is to insure that activities on the land do not pollute the Nation's streams, lakes, and rivers. This approach is far less complex and is more fair to all landowners than for pollution control experts to study a stream and try to assess portions of responsibility. A treatment plant operator can adjust his operation to meet a given effluent standard. But it is somewhat unreasonable to tell a farmer plowing his fields or a logger harvesting his trees that his operation must never exceed a given effluent or downstream water quality standard.

Instead of trying to regulate agricultural and silvicultural activities with effluent standards, compliance can be based on using proper land management practices and monitoring or inspecting these activities. Research eventually should be able to provide us with the link between downstream water quality and upstream land activities, so that management practices that are consistent with downstream water quality goals can be defined.

Making our waters fishable and swimmable by 1983 is a big job. Conservation practices will help us meet the challenge.

**Instead of trying to regulate agricultural and silvicultural activities with effluent standards, compliance can be based on using proper land management practices and monitoring or inspecting these activities.**

**Soil Conservation Movement**

The soil conservation movement, spearheaded technically by the Soil Conservation Service (SCS) and operated locally by conservation districts, has tailormade resource management systems to fit virtually every acre of land in the United States. For more than 40 years districts have been concerned about land and water use within their boundaries, and they have developed programs to solve land and water resource problems.

Each field office of SCS is equipped with a technical guide that is specifically adapted to the local field office area. These guides provide information to help soil conservationists and land users consider alternatives and arrive at decisions on how land is to be used and treated to accomplish soil and water conservation objectives. The field office technical guide is the basic SCS document that provides quality standards for planning and applying soil and water conservation practices.

SCS is an action agency. Its soil conservationists are trained and experienced in providing onsite technical assistance to land users for planning and carrying out soil and water conservation programs. This person-to-person relationship is essential in achieving soil and water conservation objectives with our Nation's farmers and ranchers. Each agricultural operation is unique. A soil conservationist, equipped with his or her knowledge, experience, and the SCS technical guide, has a special ability to consider alternatives with farmers and ranchers and help them find acceptable solutions that will be carried out. This same approach is needed to plan and apply BMP's in rural areas.

**Soil and Water Conservation Practices Corollary to BMP's**

Many soil and water conservation practices and resource management systems are corollary to BMP's. They are among the practices that are being examined and assessed for

In conservation tillage, crop residues control the movement of fine soil particles and reduce soil lost in runoff.

Contour stripcropping which alternates strips of row crops with strips of sod crops is much more effective in controlling erosion and filtering sediment than contouring alone.

A person-to-person relationship with our Nation's farmers and ranchers is essential in achieving soil and water conservation objectives.

their effectiveness in improving water quality in 208 planning that is underway throughout the Nation. Land treatment to improve water quality is site specific. Because a single practice will seldom achieve all the desired effects, a combination of practices is usually selected to meet the needs of each land and water problem. SCS has called this combination of practices a resource management system. The practices and systems that 208 planners select for their contribution to improved water quality are BMP's.

BMP's may consist of a single conservation practice or may incorporate several resource management systems. They may also include practices that help control nonpoint source pollution but that have not been thought of traditionally as soil and water conservation practices. Road-salt management, street sweeping, and pet litter management practices are some examples of this latter category.

Conservation cropping systems that include sod crops in sequence with row crops are excellent soil and water management systems. The protective and filtering effects of sod and its residues reduce the loss of sediment and agricultural chemicals from the land. Contour stripcropping, which provides for sod strips alternating with cultivated strips, is twice as effective in controlling erosion as contouring alone.

Grassed waterways are used extensively as outlets for terraces and diversion channels and for disposal of runoff from contoured rows and natural depressions. Well-sodded waterways also filter out sediment, thus further helping to improve water quality.

Terraces have been used from the time of early civilizations to control erosion where sloping land is intensively cultivated. They are effective in reducing runoff and the transport of eroded soil to stream channels and they contribute to moisture conservation. According to SCS records over 2 million kilometers of terraces have been installed nationally.

Where crop residues are adequate to provide nearly complete surface cover, no-till planting can be a very effective year-round erosion control method. This and similar conservation tillage practices have shown good results in controlling the movement of fine soil particles. There are certain problems with no-till methods that need considerable attention for resolution. They usually require more herbicides and insecticides than conventional systems. Also, nitrogen and possibly phosphorus can be leached from residues left on the surface. But the increased hazard of pollution from these soluble nutrients is usually offset by the much greater reduction in soil losses and runoff. This will become increasingly true as less persistent pesticides are used, integrated pest management practices are adopted, and fertilization timing and management practices are improved.

At left, grassed waterways filter sediment and other pollutants from runoff and safely carry excess water off fields without gullying.

At right, SCS personnel help farmers and ranchers plan conservation practices as part of resource management systems.

**Concerns for Effectiveness**

There are some unanswered questions about the total effectiveness of soil and water conservation practices in improving water quality. As water quality becomes more significant, the dynamics of the effects of applying a practice become more complex. More research is needed to improve our ability to design and apply practices and to predict with greater certainty their total effect on water quality. Problems vary considerably from site to site, and reliable research efforts are vast and expensive. Error analyses for a broad study of loading functions indicate that the margin of error could run as high as 50 percent.

Still, it is logical to use soil and water conservation practices and resource management systems to improve and maintain water quality. It is widely accepted that sediment, in terms of volume, is the greatest pollutant in our surface waters. Sediment pollution muddies the water, inhibits photosynthesis, clogs fish gills, and increases oxygen demand. Also, removing sediment from public water supplies is costly. Soil and water conservation practices have a proven ability to reduce sediment pollution by controlling soil erosion. The amount of sediment reduction that takes place as erosion is reduced depends on the sediment delivery ratio.

A good example of water quality improvement through soil and water conservation practices is the reduction of sediment rates in Georgia's Jackson Lake. In 1939, the lake's sedimentation rate was 107 acre-feet per year. By 1967 the rate had dropped to 29 acre-feet per year, and when a planned watershed project is completed, the rate should drop to 10 acre-feet per year.

Conservation practices have also helped to reduce the turbidity of intake waters at the Atlanta, Ga., waterworks on the Chattahoochee River. In the early 1930's, total suspended solids averaged 400 parts per million (ppm). As conservation practices were installed in the watershed, this declined steadily to less than 25 ppm.

These two examples illustrate the beneficial effect of using a diversified soil-conserving system of grass, livestock, trees, and row crops in conservation rotations supplemented by a complete water management system. They exemplify a change from land misuse to wise use and its beneficial effects on water quality.

Sediment is one of the significant transport mechanisms for nutrient and pesticide pollutants. More than half of the kinds of pesticides that are used on corn, cotton, and soybean rowcrops are transported by sediment. Paraquat, one of the more persistent pesticides used with no-till planting techniques, is transported on sediment. Sediment carries most of the phosphorus and organic nitrogen that get into water. The kind of soil substantially influences pesticide and nutrient transport by sediment. More research is needed on the properties of individual soils, how

Sediment kills plant and animal life in our Nation's surface waters, and carries nutrient and pesticide pollutants.

**Instead of widespread general treatment, the greatest beneficial effect on water quality is likely to be accomplished by carefully designing treatment to take care of the "hot spots" first.**

well erosion control practices control the movement of fine particles, and transport mechanisms. Until this information is available, it will be difficult to predict precisely the beneficial water quality effects of erosion control practices. The available research and information provide reasonable assurance that practices that control erosion and sediment delivery also have some effect on the reduction of pesticide and nutrient pollution. Practice design should take into account that controlling the movement of fine particles is most important because these particles have a much greater capacity than coarse particles for transporting adsorbed pollutants.

Much of the eutrophication of our lakes by nutrient enrichment is the result of increased levels of phosphorus from domestic and industrial wastes and from land runoff. In the Great Lakes, it has been estimated that diffuse sources of phosphorus may account for about 50 percent of the total tributary loading. Phosphorus entering the lakes from diffuse sources is primarily sediment associated. Practices that reduce the sediment load will, therefore, contribute to reduced phosphate loadings.

The seriousness of nonpoint problems must be carefully assessed in 208 planning and the "hot spots" clearly identified. Instead of widespread general treatment, the greatest beneficial effect on water quality is likely to be accomplished by carefully designing treatment to take care of the hot spots first. A study in a 700-hectare cultivated drainage area in the Black Creek watershed in Indiana has shown that a 40-percent reduction in stream sediment could be achieved by concentrating treatment on only 30 hectares. A study in the Great Lakes Basin by the International Joint Commission's Pollution from Land Use Activities Reference Group indicates that 60 percent of the agricultural sediment load may be generated in 30 percent of the agricultural area of the basin. This study stresses the need for concentrating on remedial measures in "hydrologically active zones."

**Developing Areas**

SCS expertise has been drawn on to an increasing extent for control of runoff and erosion in urbanizing areas. SCS technical guides have been expanded to include soil and water conservation practices that meet the needs of these developing areas. Guides and handbooks for erosion and sediment control in developing areas are also available from many conservation district offices.

The sediment load from construction sites and developing areas comes from only a small part of our total land area. Sediment problems can be very critical, however, in those areas where development and construction activities are concentrated. The polluting effect of large volumes of sediment has been readily recognized in developing areas. It is not unusual for construc-

In the Black Creek study, automatic sampling machines are used in testing the amount of sediment in streams during usual flow and during times of increased runoff. Increased stream flows trigger the machine to take samples every 20 minutes.

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**It is not unusual for construction sites to produce 10 to 20 times more sediment per unit area than agriculture.**

tion sites to produce 10 to 20 times more sediment per unit area than agriculture. Conservation districts have actively participated with State and local governments in programs to control erosion and sediment in developing areas. The National Association of Conservation Districts has provided leadership for strengthening these programs through a Model State Act for Erosion and Sediment Control.

The timely application of practices to control erosion and reduce sediment delivery from developing areas is especially important. Because excessively high rates of erosion usually do not continue very long after construction is completed, action must be immediate to be effective.

Vegetation is the first line of defense against erosion and is especially useful in developing areas. Site planning to maintain as much of the natural vegetation as possible has proved effective. Proper timing of construction operations and temporary seedings are also good management practices for construction sites. Permanent vegetation should be established as soon as conditions permit. Mulches are valuable for controlling erosion, conserving moisture, and providing stability until new plantings are established.

Structural practices, such as land grading, diversions, streambank stabilization, and grade stabilization structures, can be used where vegetative measures are not adequate for erosion control. Debris or sediment retention practices can be installed to reduce the amount of sediment delivered from construction sites. These may consist of vegetative filter strips and various structures and filters that hold water long enough for sediment to settle out.

Properly designed stormwater management programs and practices also contribute to the control of nonpoint pollution from developed and developing areas.

Debris basins at construction sites collect runoff and allow sediment to filter out of the water, helping to prevent heavy sedimentation downstream.

Vegetation established as soon as possible after construction is the best protection against erosion and sedimentation.

**Agricultural Waste Management**

Agricultural waste management systems for safely handling manure and other agricultural wastes will play an essential role as BMP's in many areas. The SCS technical guides and the waste management handbook are readily available tools for planning and installing these systems.

Waste management practices should be designed and applied to meet site-specific needs. In northern climates, for example, successful land application must rely more on the absorptive capacity of the soils and less on microbes and plant roots. Time of application is important to prevent loss of nitrogen.

A study in New York State indicates that control of barnyard runoff could provide the greatest reduction in dissolved phosphorus loadings entering Cayuga Lake. This same study also indicates that, next to sewage treatment, controlling barnyard runoff is the least costly means of reducing the dissolved phosphorus loading in central New York State.

Pastures that are well located and properly managed are not usually the source of serious nonpoint pollution problems. These pastures should be large enough and grazing distributed to keep wastes from becoming concentrated. Fencing to limit the access of livestock to streambanks will reduce aggravated streambank erosion and control the amount of defecation going directly into the stream. Fertility and pesticide management practices that provide for the proper type, timing, and rate of application are also important aspects of pasture management systems for water quality.

The hazard of runoff pollution increases when animals are crowded into lots devoid of vegetation. Practices that control runoff from manure accumulations and livestock feeding areas and the incorporation of manure into the soil immediately after spreading have proved effective. Storage facilities must be designed with adequate capacity to store drainage from silos, wash

Well-designed waste management systems for livestock feedlots prevent liquid and solid waste from entering streams, rivers, and lakes.

To avoid placing an insurmountable economic burden on American agriculture, Congress has decided that a cost-sharing program is needed to help fund the installation of practices for controlling nonpoint source pollution in rural areas.

water, and other wastes from the livestock operation for the time when spreading on land endangers water quality. Practices such as diversions that direct clean water around the site can help reduce the storage capacity that is needed.

**Irrigated Agriculture**

Irrigation has made possible some of the most productive agricultural regions in the United States. Irrigation water management systems need careful design that is based on a complete understanding of the regional hydrology. Salinity and nutrient pollution from irrigated land are two of the major problems threatening water quality.

Proper timing and the rate of irrigation water application are important for both efficiency and water quality. Runoff recovery systems can reduce polluted runoff and raise existing 50 percent efficiency ratings to 85 percent. Specific causes and relationships need to be identified to determine with greater certainty the beneficial effects of irrigation water management systems.

**Cost Sharing to Apply Practices**

Meeting water quality goals is going to be costly. SCS has estimated that it will cost $7 billion from now to the year 2000 to treat 20 percent of the most critical areas to improve water quality. The bulk of this expenditure falls on the owners and operators of our Nation's farms and ranches, and most of the benefits will be offsite. The nature of farm commodity pricing makes it very difficult, if not impossible, for farmers and ranchers to recover such expenditures. To avoid placing an insurmountable economic burden on American agriculture, Congress has decided that a cost-sharing program is needed to help fund the installation of practices for controlling nonpoint source pollution in rural areas.

Section 35 of the Clean Water Act of 1977 (Public Law 95-217) authorizes this kind of program. This new legislation calls for USDA to administer a Rural Clean Water Program (RCWP). This program will provide technical assistance and cost sharing for measures and practices to improve water quality. It will apply only to areas that are identified in 208 planning as high priority.

Technical and financial assistance will be provided to land owners and operators to help them install measures and practices to improve water quality in areas that are identified as critical in 208 plans. Cost sharing will be provided only on the basis of long-term contracts of 5 to 10 years duration. Wherever practicable, agreements will be signed to provide grants to conservation districts, State water quality agencies, and State soil conservation agencies to administer all or any part of the program locally.

The RCWP is being developed with assistance from local, State, and other Federal agencies including EPA, which must concur in the program. There is a national coordinating committee of the administrators

Installing diversion terraces helps divert runoff toward suitable outlets such as grassed waterways. Rural Clean Water Program funds will be available to farmers and ranchers for installing conservation practices to improve water quality in high priority areas.

of certain USDA agencies and EPA. State coordinating committees are to have members from USDA, State soil conservation agencies, conservation districts, and State water quality agencies.

**Summary**

The soil conservation movement, operated at the local level by conservation districts, has a significant role to play in efforts to control water pollution from nonpoint sources. Sediment is the greatest pollutant, by volume, of our Nation's streams, lakes, and rivers. Eroded soil particles, especially fine clay particles, serve to transport nutrients and pesticides that can further damage water quality. Conservation districts with SCS technical assistance have more than 40 years of experience in controlling soil erosion. The benefits of conservation practices and resource management systems are being examined in water quality management planning, and those practices and systems that are deemed effective are being selected by water quality management agencies as BMP's or components of BMP's.

Planning and application of site-specific practices are essential. SCS conservationists are experienced and equipped with the knowledge and technical guides to perform and train others to perform this task. The best approach is to concentrate on the critical areas or "hot spots" that are sources of nonpoint pollution. Soils, geology, hydrology, and climate along with land use activities are among the major items to consider in locating the hot spots and in designing the control practices.

Using conservation practices with the specific emphasis on water quality improvement is a new approach. Additional research and monitoring are needed to improve practice design and application techniques for this purpose and to predict with greater certainty the total effect on water quality.

Because the expense of installing BMP's will be great and most of the benefits will be offsite, a cost-sharing program is needed to make the installation economically feasible, especially in rural areas. Section 35 of the Clean Water Act of 1977 is intended to serve this need.

Mr. Johnson is a soil conservationist, Resource Development Division, SCS, Washington, D.C.

## What is 208?

by Frank Jeter

**Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) deals with point and nonpoint sources of water pollution. Last fall, North Carolina held a series of eight public meetings throughout the State to tell people about "208 planning."**

**The meetings stressed the role of agriculture in controlling nonpoint pollution. The Agricultural 208 Task Force, chaired by the North Carolina Soil and Water Conservation Commission, sponsored the meetings. Other members of the task force included the North Carolina Department of Agriculture, the North Carolina Agricultural Extension Service, the U.S. Department of Agriculture's Soil Conservation Service, the Farm Bureau, and the North Carolina Grange.**

**Following presentations by State and Federal agencies involved in 208 planning, the meetings were opened to questions and discussion. Some questions people asked were: "How will 208 affect me? How can this program make everyone cooperate? Will the 208 laws be enforced?"**

**The most frequently asked question was: "How much will it cost and how will it be paid for?"**

Mr. Jeter is public information officer, SCS, Raleigh, N.C.

# Erosion It's Not Just a Farm Problem

by Emmett J. Egr

**A demonstration project shows how erosion can be controlled and sediment reduced on the site of an urban housing development.**

Soil erosion and sedimentation are often thought of as strictly farm problems. But stripping the land of topsoil and vegetation during residential, industrial, and commercial development also leaves the soil bare and vulnerable to erosion. Damage caused by erosion to homesites and streets is a costly problem for landowners, and the sediment from erosion clogs and pollutes streams, rivers, and lakes.

People in the Omaha, Nebr., metropolitan area are trying to solve the erosion problems that accompany urban development. The Papio Natural Resources District (NRD) is working with the city, the county, and the Soil Conservation Service to help developers work out guidelines for controlling erosion and sedimentation at construction sites. The Papio NRD is a subdivision of the State government and covers three counties and the city of Omaha.

In fall 1977, the district began working with Creative Land Consultants, a developer, to set up a demonstration project. Gary Morgan, Papio NRD natural resources planner, and the SCS district conservationist worked with the developer on an erosion and sediment control plan for a 45-acre housing development in Omaha. Papio NRD is providing 75 percent of the erosion and sediment control project costs.

Plans include a variety of sediment and erosion control measures. Dikes were installed to divert stormwater runoff away from steep slopes, streets, storm sewers, and adjacent agricultural land. The runoff collects in several temporary sediment basins that have been installed around the construction site.

A sediment trap with a rock filter was built in one area of the construction site where there was not enough space to build an adequately sized basin. The rock filter provides secondary treatment for sediment not contained by the trap.

Bales of straw were placed as sediment barriers in drainageways and on other critical slopes to retard and filter runoff. Critical slopes were also protected with straw mulch.

To keep mud from construction vehicles off paved streets, entrances to the site were stabilized with rock 8 inches deep. The rock removes mud from vehicle tires.

After grading was completed, the topsoil was replaced and seeded. The establishment of an effective vegetative cover, such as grass or alfalfa, will phase out the need for building permanent structures to control erosion and sediment.

The first real test of the demonstration project came when moderate to heavy rains fell during and immediately after grading. Sediment and erosion were adequately controlled.

"We want to show land developers and the public that there are economical methods for controlling soil erosion," explained Grey Pearson, project coordinator for Creative Land Consultants. "We'd also like to have a role in improving the quality of life in Omaha."

The demonstration project is providing an opportunity for the Papio NRD and SCS to evaluate the effectiveness of erosion and sediment control measures and to determine if any of the measures inhibit land development. The project may also supply data for State and local studies of nonpoint source water pollution under Public Law 92-500.

Construction work goes on next to a temporary sediment basin which the developer installed to collect runoff.

Mr. Egr is director of information and education, Papio Natural Resources District, Omaha, Nebr.

# Grass in the Orchards, It's Not All Bad

by Pierce A. Drummond

**It was against tradition, but peach growers in South Carolina discovered there were benefits to letting grass grow between orchard rows.**

Fifty years ago, when commercial peach production started in Spartanburg County, S.C., the rule was to keep the ground clean. A farmer who let weeds or grass grow in his orchard was considered a slouch.

But clean cultivation was time consuming and expensive. It caused some other problems, too. After a rain, spray machines cut deep ruts into the soft, clayey soil, and it wasn't unusual to see two tractors hooked together pulling trailers full of peaches out of the orchard at harvesttime. Soil losses were terrific, and the hills that weren't in peaches were in clean-tilled cotton and corn, compounding the erosion problem.

The Soil Conservation Service recommended using permanent sod strips of tall fescue between the rows of trees to control erosion and make it easier to get machinery in and out of the orchards. In the 1960's, producers began using sod strips and discovered that peaches could be grown using the strips between each row equally as well as in clean-tilled orchards.

Olin Blackwell of Inman, S.C., is one of the growers who changed from clean cultivation to using sod strips in his 250-acre orchard. "It just doesn't make sense to disk an orchard several times a year, when you can use the grass to keep equipment out of the mud and cut down on erosion," Blackwell said. "After I get a 14-foot strip of tall fescue established between each row, I work around the trees with a mechanical hoe. On the older orchards I use a herbicide along with occasional hoeing to control weeds around the trees. The only implements I use for cultivation are a rotary mower, a mechanical hoe, and a herbicide sprayer."

Sod strips between rows of trees keep machinery from sinking into soft soil.

Spartanburg County has about 24,000 acres of peaches which rank it among the top peach counties in the Nation. Blackwell estimates that 90 percent of the growers in the county currently use permanent sod in their orchards.

"If you don't spray sulfur to control brown rot during a rainy season, you don't have marketable peaches at harvest," Blackwell said. "The sod strips will hold up spray equipment even when the ground is wet. But you have to fertilize the grass to get it established and to maintain a heavy sod. Heavy sod is essential to withstand traffic and control runoff."

The green, mowed strips between the rows of trees give Blackwell's orchards a landscaped appearance. His older orchards are contoured and the rows are planted on small beds so each row acts as a miniature terrace. He and some of the other growers in the county are trying straight rows in new plantings. "On gently sloping land straight rows with a good sod will work," said Blackwell. "But you'd better stay with contoured rows on steep land."

Mr. Drummond is district conservationist, SCS, Spartanburg, S.C.

# Cheatgrass Gets Caught with Conservation

by Fred Trump

## Three Kansas wheat farmers use conservation methods such as crop rotation and minimum tillage to control cheatgrass.

One of the toughest problems for Kansas wheat farmers who try to grow continuous wheat occurs during unusually wet and unusually dry seasons. That problem is cheatgrass. Also known as downy brome, this weed pest competes heavily with the wheat crop.

However, there are several ways of controlling cheatgrass other than the too common practices of excessive tillage and burning of stubble, according to Earl J. Bondy, Soil Conservation Service conservation agronomist at Salina. The cheatgrass problem in Kansas, he pointed out, is not unlike the weed problems that occur in continuous cropping in other parts of the country.

"More tillage of wheat ground than is necessary only wastes time and precious fuel, and exposes the soil to wind and water erosion—without doing anything to control cheatgrass," he said.

"Burning stubble destroys valuable organic matter needed to maintain good soil tilth. But it has little or no effect upon cheatgrass seed, which has already shattered and fallen to the ground. Many farmers have found that burning stubble makes their soil 'hard as concrete.'

"The best way to control cheatgrass is a crop rotation that breaks up the sequence of continuous wheat," Bondy advised. "Just as johnsongrass and shattercane in sorghum are controlled by bringing wheat into the rotation, so can cheatgrass in wheat be knocked out by alternating wheat with sorghum."

Larry Sneed of Kiowa County is a concerned conservation farmer who maintains wind stripcropping and terraces where needed and does as little tillage as possible. Even when cheatgrass has become a problem in the past 3 years, he has gone to a variety of techniques that are not in conflict with good conservation farming.

V-blade sweeps that operate horizontal to and just below the soil surface are effective in Kansas as a tillage tool to control weeds in wheat stubble. Most of the stubble remains on the soil surface to protect the soil against wind and water erosion.

On sandyland he follows a rotation of wheat, grain sorghum, and fallow to control cheatgrass. A further benefit for him has been considerably higher yields of both crops.

After wheat harvest in June on sandyland, the stubble is not touched until the following April. Then the stubble and weed growth are "bladed" once or twice with sweeps. The field is then disked with an offset disk in mid-May prior to grain sorghum planting about June 1. Sneed pulls a packer behind the disk, a practice he uses to control wind erosion on this type of soil.

The grain sorghum is cultivated three times—once with a horizontal knife, once with a spiketooth harrow, and once with a disk cultivator or rolling-type cultivator.

After the sorghum is harvested in late September, the field lies fallow until mid-September of the following year. The only tillage he does is during the summer—blading the field with the offset disk and packer.

Sneed finds that his well-timed "minimum of tillage" controls weeds without the expense of herbicides. He feels that the effects of herbicides are not very predictable, particularly on sandyland.

On hardland he has used both a wheat-fallow rotation and continuous wheat. Tillage with sweeps in the wheat-fallow rotation on much the same schedule as on sandyland keeps cheatgrass under control. When cheatgrass and thistles

threatened his continuous wheat production in 1977, he disked the weeds and stubble under in the spring and planted the field to grain sorghum. The temporary wheat-sorghum rotation solved the weed problem.

The heart of weed control on the 280-acre farm of Roy Anderson, Clay County, is contained in the two words "crop rotation." When cheatgrass is not a problem on a particular field, he has a crop rotation of 2 years of wheat and 1 or 2 years of grain sorghum.

On 40 acres, however, he used a 2-year, wheat-grain sorghum rotation to control cheatgrass. He plants wheat around the first week in October—at the time of the Hessian fly-free date. This is not so much because of this insect as to give cheatgrass and volunteer wheat a chance to be killed by a one-time tillage after sorghum with sweeps early in September. In a wet September he has to go over the field twice with sweeps.

"Some farmers," Anderson said, "are so concerned about planting wheat early enough so there will be some growth before the winter dry season that they overlook the need to control cheatgrass just before planting. Burning stubble doesn't help control cheatgrass a bit. That only burns up $10 to $15 worth of nutrients per acre."

When grain sorghum follows wheat, Anderson follows the same September tillage program, with no tillage between wheat harvest and September.

"I don't need to work the wheat stubble before then," he said. The following spring in mid-May he sprays for bindweed, then disks the ground, and plants grain sorghum.

"Rotation and minimum tillage have done the job for me in controlling cheatgrass," the Clay County farmer added. "I haven't needed a herbicide to control cheatgrass."

But for general weed control on fields going into sorghum, Anderson uses a herbicide. He applies one pound of atrazine per acre in bands over the rows at planting time. Cheatgrass is not a problem during planting if it has been controlled earlier by timely minimum tillage.

Similar weed control—and tractor fuel savings—are accomplished on another 75 acres in a 3-year rotation of wheat, sorghum, and oats. The rotation from sorghum to spring-seeded oats is easier than going from sorghum to wheat, according to Anderson.

A herbicide, such as atrazine, can be applied for cheatgrass control after wheat harvest if sorghum is to be planted the following spring, said Bondy. If sorghum is planted in wheat stubble immediately after wheat harvest, any of several other herbicides control cheatgrass.

Atrazine can also be used in a wheat-fallow rotation, provided it is applied about a year before planting wheat. Farmers, of course, should read the label before each use of a herbicide, and apply only as directed, in amounts and at times specified.

Willis Brandyberry, a Graham County Conservation District supervisor, is convinced that the herbicide atrazine pays in his wheat-grain sorghum-fallow rotation. He undercuts the stubble and weeds and applies anhydrous ammonia right after wheat harvest. Atrazine applied to wheat stubble in midsummer effectively controls cheatgrass, redroot, pigweed, and fireweed (Kochia) through the sorghum crop the following year. If the summer is especially dry, the herbicide will control Russian thistle and sandbur, too. Only if the spring is wet does Brandyberry use sweeps in the stubble before planting sorghum. Otherwise, no spring tillage is used.

On his native grassland, Brandyberry has installed a planned grazing system. He expects this will rejuvenate the native grasses and crowd out the cheatgrass that is a source of infestation for his cropland.

Cheatgrass often grows in abundance along roadsides, in road ditches, on overgrazed rangeland, and in wasteland areas. Bondy advises herbicide treatment or mowing before the grass goes to seed. Uncontrolled cheatgrass in such areas is a massive source of cheatgrass seed infesting wheatfields. Rotational grazing of native grassland is effective in controlling cheatgrass, too, he advised.

It is also important, he added, to plant clean wheat and grass seed. Cheatgrass seed is often found in small grain and grass seed.

Mr. Trump is public information officer, SCS, Salina, Kans.

# Help to Make It Through the Drought

by F. Dwain Phillips

**Through the Great Plains Conservation Program, a rancher in Oklahoma was able to beat the odds—little available water, rough terrain, and erosion.**

For Wesley Matteson, a rancher in Woodward County, Okla., developing a reliable source of water for his livestock operation was a real challenge.

Matteson operates 10,080 acres northeast of Woodward and has 550 head of cattle. He was plagued by uneven grazing distribution and erosion, especially in dry years, due to an inadequate water supply.

Bedrock is so close to the surface in his area it is difficult to dig ponds, and the ponds that are installed either leak or go dry in summer because of the low rainfall and inadequate watersheds. Matteson tried digging wells, but water was hard to find and it usually had a high mineral content, making it unsuitable as drinking water for livestock.

His worst erosion problem was on a 2,600-acre pasture of native grass where a few shallow ponds and a natural spring were the only sources of water for livestock. Areas around the ponds and spring were overgrazed and severely eroded while other areas of the pasture were not grazed at all. The rough terrain in the pasture made it impossible to use crossfencing to improve the grazing distribution.

Through the Great Plains Conservation Program (GPCP), the Soil Conservation Service helped Matteson solve the problem. SCS provided him cost sharing and technical assistance in the installation of more than 11 miles of plastic water lines and nine metal livestock watering tanks.

Matteson rented a ditch-digging machine, and, with help from family members, dug a 3-foot-deep trench and laid more than 58,000 feet of pipe. The pipe was hooked to a rural water line, and the tanks were arranged in the pasture to distribute grazing evenly and reduce erosion. Up to 3,000 gallons of water is pumped to the tanks daily.

More even distribution of grazing has resulted in healthier plants that maintain uniform growth even through drought years. Matteson has established a year-round stocking rate of one cow to 20 acres and can still maintain adequate grass cover.

In 1975, for his work in protecting and improving the land, the Woodward County Conservation District named Matteson as their outstanding district cooperator. He also received special recognition for meeting the schedule in his conservation plan.

In addition to his livestock operation, Matteson grows wheat and sudangrass hybrids on 755 acres of cropland. He has built 41,000 feet of terraces on the cropland and has 15,000 more feet of terraces planned as part of his GPCP contract. Contour farming, managing surface residue, and planting 12 acres of bermudagrass to stabilize streambanks are other practices included in the plan.

Matteson's GPCP contract was developed for 5 years, and it is scheduled to be completed this year. Under the contract, he has been able to provide his livestock with an adequate and dependable supply of water, to achieve even grazing, to reduce erosion, and to improve his cropland.

Mr. Phillips is public information officer, SCS, Stillwater, Okla.

One of nine metal stockwater tanks helps an Oklahoma rancher distribute his cattle herd for even grazing.

# Grazing Through All Kinds of Weather

by T. B. Trew
and Helen S. Jeter

## Year-round planned grazing systems are helping Virginia cattlemen during good weather and drought.

Virginia is rich in natural resources. But the need for wise use and good management of these resources became especially apparent during the extremely dry summers of 1976 and 1977. Many Virginia cattlemen were forced to buy high-priced hay to feed their livestock or to sell their cattle on a depressed market.

Cattlemen who had year-round planned grazing systems for their pastures fared much better. They didn't have to winter feed until February 1977, or later, and they didn't have to feed at all in summer. In addition, they saved $40 to $50 on the annual cost of keeping a cow.

In Virginia, Soil Conservation Service personnel are working through soil conservation districts to help farmers put their pastures into year-round planned grazing systems. Each system is designed to meet a farmer's needs and to suit his soils, plants, and livestock operation. Grasses and legumes are fertilized or managed to provide grazing for cattle.

Nelson Diehl of Rockingham County has the oldest known planned year-round grazing system in the State. Diehl uses Kentucky 31 fescue and bluegrass-white clover mixture in his system. He fertilizes the fescue each August with 60 pounds of nitrogen per acre. Growth is allowed to accumulate or stockpile until November. Cows graze the fescue during the winter and again in early summer. Bluegrass furnishes spring and fall grazing. Based on soil tests, lime, phosphate, and potash are applied on all the pastures. Hay made from the fescue is stored and fed to the livestock only when snow covers the grass.

Diehl claims that he would not be able to keep cows without a planned grazing system, especially in dry years like 1976 and 1977.

Another Virginia cattleman, W. T. Barnes of Blackstone, said, "My planned grazing system has served me well for several years. It has meant more to me during the dry years than ever before."

According to William Wampler of Harrisonburg, his planned grazing system has enabled him to increase his stocking rate.

There are many advantages to year-round planned grazing systems. Cattlemen enjoy about an 80-percent reduction in hay, labor, and machinery needs. Cattle are healthier because they are out grazing most of the year. Most cattlemen also report increased weaning and stocking rates. Grasses and legumes are more productive and less affected by droughts.

Until recently, winter grazing has been a missing link in Virginia grazing systems. Now, Kentucky 31 fescue makes year-round grazing possible. It is fertilized in August and stockpiled for winter grazing. Orchardgrass, bluegrass, native grasses, and legumes are managed or fertilized to produce grazing when needed by the livestock at other times of the year.

Rotation grazing also is a part of the planned grazing systems. It avoids overgrazing and helps keep plants healthy and strong. Properly grazed pastures have quicker regrowth following rains than those that have been overgrazed.

The future looks brighter for Virginia cattlemen. About 15 percent of them are now using planned grazing systems or are in the process of establishing them. Year-round planned grazing systems are giving the State's livestock industry a much-needed economic boost—even during droughts.

Mr. Trew was an agronomist, SCS, Richmond, Va., and is now retired. Ms. Jeter is public information officer, SCS, Richmond, Va.

A. G. Updyke is one of many Virginia farmers who graze their cattle year round. Cattle are fed hay only when the grass is completely covered by snow.

# 'Garrison' Creeps into South Dakota

by F. Dee Watson

**'Garrison' creeping foxtail is a grass that is helping farmers in South Dakota and other Northern States make good use of poorly drained cropland.**

Farmers in Brookings County, S. Dak., have converted many acres of low, poorly drained cropland into productive pastures and haylands by planting 'Garrison' creeping foxtail, *Alopecurus arundinaceus*.

"In 6 out of 10 years I couldn't get a crop on some fields because they were too wet," said Herb Vaske, who farms near Aurora, S. Dak. "I decided to put the fields into grass for my cattle." The grass Vaske selected was Garrison creeping foxtail. Using the Brookings Conservation District's grass drill, he planted the grass in late August 1973, and the next year he harvested the field for hay.

"During drought years, grazing the low areas planted in Garrison was the only thing that saved me and my farm," said Harold Evenson, who farms near Sinai, S. Dak.

Creeping foxtail is a grass native to Europe and Asia. It was brought to McLean County, N. Dak., by an immigrant homesteader. In 1950, a Soil Conservation Service plant materials specialist collected seed from fields of creeping foxtail near Max, N. Dak. The seed was increased at the Bismarck, N. Dak., Plant Materials Center (PMC). After years of selection and field testing the named variety, Garrison creeping foxtail, was released by the Wyoming Agricultural Experiment Station in cooperation with the PMC.

The first seeding of Garrison creeping foxtail in South Dakota was on the Allan Watt farm near White. A 12-acre field was planted for seed production using certified seed from the PMC. Watt and his son, Greg, now have 50 acres seeded to Garrison creeping foxtail which they use for pasture and hay or for producing seed. SCS provided technical assistance in the original planting and harvesting of Garrison on the Watt farm.

Only wet ground should be seeded in Garrison. Seeding can be done in April or May if it's not too wet to get onto the land, or in the first part of September. Watt prepares the seedbed by disking twice and packing it thoroughly. He uses a two-wheeled fertilizer spreader with an agitator and plants about 5 to 6 pounds of seed per acre. After planting, Watt harrows the field once to barely cover the seed.

It takes about 3 years to get well-established sod. Not grazing it the first season allows the plants to fully develop. In some places, established Garrison sod has been under about 2 feet of water for almost 3 weeks without drowning out.

Watt uses 90 to 120 pounds of actual nitrogen per acre for good yields. South Dakota State University ran a fertility test on his land in 1969. Test results showed that applying 60 pounds of nitrogen increased the hay yield from 690 pounds to 1,940 pounds per acre. Applying 120 pounds of nitrogen increased the yield to 3,590 pounds of hay per acre.

According to Watt, Garrison creeping foxtail is not a heavy seed producer. He gets about 100 pounds of seed per acre. Watt says the best time to harvest the seed is the end of June and beginning of July.

He windrows the grass, cutting just below the leaf tops so that the heads will have some stubble to rest on. He lets it dry for about 3 days, and then runs his combine with the air shut off so that he will not lose the very light seed.

Watt's seed has been sold in Illinois, Minnesota, North Dakota, and Colorado, as well as many places in South Dakota. He says more than 2,000 acres in Brookings County have been seeded to Garri-

At right, 'Garrison' creeping foxtail produces a high-quality hay readily eaten by livestock. Far right, Greg Watt examines Garrison stubble on a low area.

son. "Most people don't want to bother with taking seed, so they just graze it," Watt said.

After Watt collects the seed, he mows the field for hay. He starts in the center of the field and mows out, going against the wheel tracks in order to get all the hay. He lets it lie in the swath to dry. Then, using a side delivery rake, he bales or stacks the hay right away. Garrison hay is very fluffy and even a slight wind can blow it into the fences.

"There are many areas of low, poorly drained cropland being farmed in this part of the State," Watt said. "If they were planted in a productive grass like Garrison creeping foxtail, just think how much they could help farmers through the dry years."

Mr. Watson is district conservationist, SCS, Brookings, S. Dak.

# Meetings:

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|---|---|
| **August** | |
| 6–9 | American Agricultural Economics Association, Blacksburg, Va. |
| 13–16 | Conservation Education Association, Logan, Utah |
| 13–16 | National Farm & Power Equipment Dealers Association, Calgary, Alberta, Canada |
| 13–17 | National Association of County Agricultural Agents, Boise, Idaho |
| 14–18 | First International Rangeland Congress, Denver, Colo. |
| 21–25 | American Fisheries Society, Kingston, R.I. |
| **September** | |
| 10–14 | International Association of Fish and Wildlife Agencies, Baltimore, Md. |
| 12–16 | Federal Bar Association, Washington, D.C. |
| 23–28 | Environmental Sanitation and Maintenance Educational Conference, Exposition, Baltimore, Md. |
| 25–28 | Interstate Conference on Water Problems, Charleston, S.C. |
| 27–Oct. 1 | American Institute of Planners, New Orleans, La. |
| **October** | |
| 1–6 | Water Pollution Control Federation, Anaheim, Calif. |
| 6–10 | American Horticultural Society Congress, Nashville, Tenn. |
| 8–10 | American Forestry Association, Hot Springs, Ark. |
| 11–13 | American Water Works Association, Chesapeake Section, Norfolk, Va. |
| 14–17 | Farm and Industrial Equipment Convention, Boca Raton, Fla. |
| 14–18 | Congress for Recreation and Parks, Miami Beach, Fla. |
| 16–20 | American Society of Civil Engineers, Chicago, Ill. |
| 17–20 | National Conference of Editorial Writers, Detroit, Mich. |
| 21–25 | American Bankers Association, Honolulu, Hawaii |
| 23–26 | The Geological Society of America, Toronto, Ontario, Canada |
| 25–27 | Adult Education Association of the United States of America, Portland, Oreg. |
| 26–29 | National Association of Biology Teachers, Chicago, Ill. |
| 29–Nov. 1 | The Irrigation Association, Palm Springs, Calif. |
| 29–Nov. 2 | American Association of State Highway and Transportation Officials, Louisville, Ky. |

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